ANALYSIS OF PLANT VEGETATION

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Abstract

Vegetation is very important for keeping the environment balanced and for supporting farming. Checking how plants are doing helps to know about the land's quality, how crops are growing, and how the environment is changing. This project shows a system for analyzing plant vegetation using the Normalized Difference Vegetation Index, or NDVI. NDVI is a common method used in remote sensing to check how healthy plants are. It works by using satellite images to compare the amount of near-infrared light and red light. Healthy plants reflect more near-infrared light and take in more red light, which gives a higher NDVI value. In this project, we use images from the Sentinel-2 satellite along with the Google Earth Engine platform to process vegetation data properly. A web app has been made so that users can easily analyze vegetation. The user can pick any place on an interactive map. Once the location is chosen, the system gets the satellite data, calculates the NDVI value, and shows the vegetation condition like poor, moderate, or healthy. The system is easy to use and doesn't need any knowledge about satellite data or GIS tools. This project helps with farming, environmental research, and land care by offering clear and reliable information about plant health.

Keywords: *NDVI, Vegetation Analysis, Sentinel-2, Google Earth Engine, Remote Sensing, Web Application*

I. Introduction

Vegetation plays a key role in the natural world. It helps keep the climate stable, protects the soil, and supports farming and animals. Checking the health of plants is important to spot issues like stress, land damage, and changes from weather or human actions.

Old ways of checking vegetation, like going into the field, take a lot of time and work. These methods are expensive and can only cover small areas. Because of this, it's hard to check large areas often.

Satellite remote sensing is a better way to check vegetation. It lets us look at big areas quickly. One common tool used is the Normalized Difference Vegetation Index, or NDVI. NDVI uses light from satellites in red and near-infrared colors to measure how healthy plants are. Higher NDVI values mean plants are

doing well, while lower values show less healthy or sparse plant cover.

Even though tools like Google Earth Engine are strong for analyzing vegetation, they need programming skills. This project is designed to make it easier by creating a simple web app that lets people analyze vegetation using NDVI without needing to know how to code.

II. Related Work

Many vegetation analysis systems use NDVI to check plant health. GIS software like QGIS and ArcGIS can calculate NDVI, but these tools need to be installed and require some technical knowledge. Users have to understand how to process satellite data and use GIS concepts to use them properly.

Google Earth Engine is popular among researchers because it offers free access to satellite data and uses the cloud for processing. However, using GEE needs programming skills in JavaScript or Python, which can be tough for people who are just starting out.

There are some web-based tools for monitoring vegetation, but many only show static images or offer limited analysis. They might not support real-time NDVI calculations or give accurate results based on location.

The proposed system is better than existing options because it offers real-time NDVI calculation, simple map-based location selection, and clear vegetation classification. The system focuses on making things easy to use and ensuring accurate results.

III. System Architecture

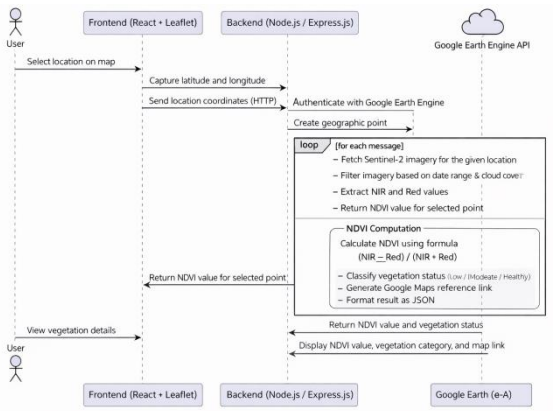
The Plant Vegetation Analysis system uses a client-server setup. It has three main parts: the frontend, the backend, and cloud processing.

The frontend is built with ReactJS and Leaflet. It shows an interactive map where users can click on any spot. When they click, the system gets the latitude and longitude of that place and shows it. It also displays the NDVI results and the condition of the vegetation there.

The backend is made with Node.js and Express.js. It gets the location data from the frontend and connects to Google Earth Engine. Authentication is done securely through a service account.

Google Earth Engine works with Sentinel-2 satellite images. It calculates NDVI values using different spectral bands and sends the results back to the backend, then to the frontend.

This setup makes sure data is accessed securely, processing is fast, and the system can grow easily as needed.



IV. Implementation

The Plant Vegetation Analysis system is built to connect the user interface with satellite data processing in a simple and efficient way. It is made up of three key parts: the frontend, the backend, and cloud-based processing.

First, secure access to Google Earth Engine is set up using a service account. This allows satellite data to be accessed safely without sharing login information with users. Once the authentication is done, the backend server is ready to handle user requests.

When a user clicks on a location on the interactive map, the frontend collects the latitude and longitude of that point. These coordinates are sent to the backend via an HTTP request. The backend then uses this data to identify the selected area as the region of interest.

Next, Sentinel-2 satellite images that cover the selected area are fetched from Google Earth Engine. From these images, the necessary spectral bands are extracted. The near-infrared band (Band 8) and the red band (Band 4) are used for analyzing vegetation.

The Normalized Difference Vegetation Index (NDVI) is calculated using the standard formula:

NDVI = (NIR - Red) / (NIR + Red)

This calculation takes place on the Google Earth Engine platform to ensure quick and accurate results.

Based on the NDVI value, the system classifies the vegetation into categories like low vegetation, moderate vegetation, and healthy vegetation.

Finally, the calculated NDVI value, vegetation condition, and location information are sent back to the frontend. The results are shown clearly to the user along with a map view. The system is designed to handle multiple requests smoothly and can be expanded with more features in the future.

V. Results

The Plant Vegetation Analysis system was tested in various places like farmland, open spaces, and areas with some vegetation. For each place chosen, the system managed to get Sentinel-2 satellite images and worked on them without any problems.

The NDVI values the system calculated correctly showed how healthy the plants were in each area. Places with lots of green and strong plants had higher NDVI numbers, while areas with few or weak plants had lower numbers. The way the system classified the vegetation was easy to understand for people using it.

The system worked the same way in all the different areas and gave consistent results. Using Google Earth Engine helped get reliable satellite data quickly and made processing faster. The interactive map made it simple to pick locations and improved how users felt about the system overall.

The results show that the system is good at giving accurate vegetation information in a simple and easy-to-use way.

VI. Future Work

The system could be made even better by adding some advanced features. One key improvement would be time-series NDVI analysis, which allows us to track how vegetation changes across different seasons and over several years. This helps in identifying long-term trends in plant growth. Including cloud masking techniques would also improve the accuracy of NDVI results in areas where satellite images are blocked by clouds. This makes the data more reliable, especially in regions that often have cloudy weather.

Additionally, the system could support more satellite data sources like Landsat and MODIS, which would expand its coverage and make it more adaptable. Other possible upgrades might involve creating visual charts to show NDVI trends, comparing different locations, and designing a mobile version of the app for easier access. These improvements would make the system more effective for monitoring large areas of the environment and planning agricultural activities.

VII. Conclusion

This project shows how a simple and effective web-based system can be used to analyze plant vegetation using NDVI and satellite images.

By combining Google Earth Engine with up-to-date web technologies, the system offers accurate and dependable information about vegetation health in a way that's easy to understand. The application makes it possible to analyze vegetation without needing any expertise in remote sensing or GIS.

Users can simply pick a location on a map to get insights. This system is helpful for monitoring agriculture, studying the environment, and managing land resources. In general, the project emphasizes the value of using satellite data for vegetation analysis.

It also demonstrates how cloud-based platforms can be used to create practical and easy-to-use tools for environmental monitoring. The system serves as a solid base for future improvements and real-world use.

VIII. References

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